REMARKS

Applicants have: (a) amended claims 2-13, 17, 19, 21-26, and 29-31; (b) canceled claims 1, 20, and 27-28; and (c) added new claims 32-35.

Examiner objected to claim 13. In particular, the Examiner stated:

> Claim 13 is objected to because of the following informalities: dependency is claimed from "claim 14". The examiner believes this should be "claim 11". Appropriate correction is required.

Applicants have amended claim 13 to correct the informality noted by the Examiner. As such, Applicants respectfully request the Examiner to withdraw this objection.

Examiner rejected claims 27-31 under 35 U.S.C. 112, second paragraph. In particular, the Examiner stated:

> Claims 27-31 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.
>
> Specifically, the use of the limitation "detector" is confusing. It appears that the applicant might be claiming two different detectors, however given the specification and figures the examiner believes that these detectors are the same, such that the detector in the spectrum analyzer is the same detector that is in optical communication with the lens assembly.

Applicants have canceled claims 27-28. As such, Applicants respectfully request the Examiner to withdraw this rejection.

Examiner rejected claims 1, 5-10, 20, and 24-28 under 35 U.S.C. 102(b). In particular, the Examiner stated:

> Claims 1, 5-10, 20, and 24-28 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by U.S. Patent No 6,081,334 to Grimbergen et al (hereafter Grimbergen).
>
> As to claims 1 and 19, Grimbergen discloses a method for determining characteristics of a film on a wafer in a processing chamber including (see figures 3a, 3b and 6, also column 12, lines 47-54): impinging optical radiation upon said film; sensing optical radiation reflected by said film to form spectral signals containing information concerning interference fringes; and obtaining thickness information of said film as a function of a periodicity of said interference fringes.
>
> As to claims 5 and 6, Grimbergen discloses collecting and collimating cylindrical radiation by means of a lens assembly (see figure 2, 74a, 74b).

As to claim 7, Grimbergen discloses collecting two "bundles of rays" formed by reflections of two interfaces (see figures 4a, 4b, 4c).

As to claim 8, Grimbergen discloses exposing the wafer to plasma (see column 6, lines 36-54).

As to claim 9, Grimbergen discloses exposing the wafer to white light (see column 7, lines 19-36).

As to claim 10, Grimbergen discloses detecting multiple peaks corresponding to thickness (see column 13, 14).

As to claims 20, 27 and 38, Grimbergen discloses an apparatus including (see figure 2):

a processing chamber (42);

a system to generate optical radiation (66, 74a, 74b, 86);

a spectrum analyzer having a detector (70);

a processor in communication with said analyzer (72);

a memory in communication with said processor, said memory comprising a computer readable medium having a program therein, said program causing a processor to obtain thickness information as a function of interference fringe periodicity (72).

As to claim 24, Grimbergen discloses a plasma generation apparatus (56).

As to claims 25-27, Grimbergen discloses a lens assembly for light collimation and the collection of cylindrical radiation (74a, 74b).

Applicants have amended claims 5-10, and 24-26, and canceled claims 1, 20, and 27-28. As such, Applicants respectfully traverse the Examiner's rejection.

Applicants respectfully submit that Grimbergen teaches method and apparatus for endpoint detection for semiconductor processes that is completely different from the method and apparatus of the pending claims. In particular, as set forth in col. 3, lines 24-34, Grimbergen teaches measuring the intensity of light reflected from a wafer over time to determine a measured waveform pattern. Then, the measured waveform pattern is compared to a predetermined characteristic waveform pattern, and when the two waveform patterns are substantially the same, the process conditions are altered to change a rate of processing or a process selectivity ratio of a layer on the substrate. See also, Grimbergen at col. 7, lines 5-18; col. 13, lines 13-19 and 42-47; and col. 14, lines 16-29.

In addition, Grimbergen discloses at col. 11, lines 42-65 that the intensity of reflected light from a layer varies periodically with the thickness of the layer and that the period spacing depends on the wavelength of the incident light. Further, Grimbergen discloses that the intensity of the reflected light undergoes periodic maxima and minima (illustrated in FIG. 5). Lastly, Grimbergen states that the interference phenomenon is described by $2d=N(\lambda/\eta)$ (where λ

is the wavelength of laser light, η is the refractive index of a layer, and d is the thickness of the layer), where the interference is constructive for integral values of N and is destructive for half-integer values of N.

Regarding claims 5-9: Applicant respectfully submit that claims 5-9 require "reforming said spectral reflectance signals into a form of intensity versus a reciprocal of wavelength" and "obtaining thickness information as a function of a distance between adjacent maxima or minima of the reformed spectral reflectance signals." Grimbergen does not teach, hint or suggest either of these requirements. In addition, claim 9 requires "exposing said wafer to white light," and Grimbergen does not teach, hint or suggest this requirement. As such, Applicants respectfully submit that Grimbergen does not anticipate claims 5-9.

Regarding claim 10: Applicant respectfully submit that claim 10 requires "reforming said spectral reflectance signals into a form of intensity versus a reciprocal of wavelength" and "obtaining thickness information as a function of a distance between adjacent maxima or minima of the reformed spectral reflectance signals." Grimbergen does not teach, hint or suggest either of these requirements. In addition, claim 10 requires "mapping said reformed spectral reflectance signals into a frequency domain." Grimbergen does not teach, hint or suggest this requirement. As such, Applicants respectfully submit that Grimbergen does not anticipate claim 10.

Regarding claims 24-26: Applicant respectfully submits that claims 24-26 require "said computer-readable program including a set of instructions to cause said processor to operate on said information and obtain thickness information of said film; wherein said set of instructions includes a subroutine to cause said processor to reform said spectral reflectance signals in a form of intensity versus a reciprocal of wavelength and to obtain thickness information as a function of a distance between adjacent maxima or minima of the reformed spectral reflectance signals." Grimbergen does not teach, hint or suggest these requirements. As such, Applicants respectfully submit that Grimbergen does not anticipate claims 24-26.

In light of the above, Applicants respectfully request that the Examiner withdraw this rejection.

Examiner rejected claims 2-4, 11-18, 21-23, and 29-31 under 35 U.S.C. 103(a). In particular, the Examiner stated:

> Claims 2-4, 11, 12-18, 21-23 and 29-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grimbergen.
>
> As to claims 2-4, 11-18, 21-23 and 29-31 Grimbergen teaches analyzing the data with respect to wavelength.
>
> With further regard to claims 4, 13, 23 and 31, Grimbergen teaches determining the etch rate of the film with respect to wavelength during an interval of time (see column 9, lines 23-45).
>
> Grimbergen does not teach analyzing the data with respect to the reciprocal of the wavelength domain, or as it is commonly referred to, the frequency domain.
>
> It is notoriously well known in the art that the reciprocal of wavelength is frequency and this relationship is given by the following formula:
>
> $\lambda = c/f$ where λ is wavelength, f is frequency, and c is the speed of light.
>
> It would have been obvious to one of ordinary skill in the art at the time of invention to analyze the spectral data with respect to frequency instead of wavelength, as it is often desirable to interpret interferometric data in multiple domains, including both frequency and wavelength domains for purposes of clarity and analysis.
>
> As to the further limitations of claims 11-18, please see the teachings in the rejection of claims 1 and 5-10 above.

Applicants have amended claims 2-4, 11-13, 17, 21-23, and 29-31. As such, Applicants respectfully traverse the Examiner's rejection.

Regarding claim 2-4: The Examiner stated that "As to claims 2-4, ... Grimbergen teaches analyzing the data with respect to wavelength." Applicants respectfully submit that the Examiner is incorrect, and that instead, Grimbergen discloses generating reflected intensity waveform patterns over time using various wavelengths of radiation to determine which wavelength of radiation produces a waveform pattern which is readily recognized by a computer.

The Examiner also stated that "Grimbergen does not teach analyzing the data with respect to the reciprocal of the wavelength domain, or as it is commonly referred to, the frequency domain." Applicants agree that Grimbergen does not teach analyzing data with respect to 1/wavelength. Lastly, the Examiner stated that "It would have been obvious to one of ordinary skill in the art at the time of invention to analyze the spectral data with respect to frequency instead of wavelength, as it is often desirable to interpret interferometric data in multiple domains, including both frequency and wavelength domains for purposes of clarity and analysis." Applicants respectfully submit that there is no basis in any of the cited references for this

statement. In addition, Applicants respectfully submit that there is no teaching of why this would be desirable since the term "purposes of clarity and analysis" are amorphous terms that provide no indication of motivation. Moreover, Applicants respectfully submit that there is no teaching, hint or suggestion in Grimbergen or in any other cited reference that distances between adjacent maxima or minima (while being wavelength dependent when viewed in the form of intensity versus wavelength) are advantageously wavelength independent when viewed in the form of intensity versus 1/wavelength in accordance with claims 2-4.

In addition, as to claim 4, there is no teaching, hint or suggestion, in Grimbergen or in any other cited reference, that an etch rate may be determined as a function of a change in frequency of a peak in a frequency domain mapping of intensity versus 1/wavelength in accordance with claim 4. As such Applicants respectfully submit that claims 2-4 are patentable over Grimbergen.

Regarding claim 11-18: As set forth above, neither Grimbergen nor any other cited reference teaches, hints or suggests, as required by claims 11-18, reforming spectral reflectance signals into the form of intensity versus a reciprocal of wavelength; mapping the reformed spectral reflectance signals into a frequency domain; and determining film characteristics as a function of frequency information related to peaks of intensity in the frequency domain, where the film characteristics include a thickness of a film. Further, even if the Examiner were correct in asserting that one of ordinary skill in the art would reform spectral reflectance signals (Applicants submit that the Examiner is not correct), Applicants respectfully submit that such a one of ordinary skill: (a) would not map the reformed spectral reflectance signals into the frequency domain, and (b) would not determine film characteristics as a function of frequency information related to peaks of intensity in the frequency domain as required by claims 11-18. As such Applicants respectfully submit that claims 11-18 are patentable over Grimbergen.

Regarding claim 21-23: Applicants respectfully submit that neither Grimbergen nor any other reference teaches, hints or suggests reforming spectral reflectance signals into the form of intensity versus 1/wavelength. In addition, Applicants respectfully submit that neither Grimbergen nor any other reference teaches, hints or suggests that distances between maxima or

minima (while being wavelength dependent when viewed in the form of intensity versus wavelength) are advantageously wavelength independent when viewed in the form of intensity versus 1/wavelength in accordance with claims 21-23. In further addition, Applicants respectfully submit that neither Grimbergen nor any other cited reference teaches, hints or suggests: (a) to map spectral reflectance signals in the form of intensity versus 1/wavelength into a frequency domain or (b) to determine a thickness of a film as a function of frequency of a peak of intensity in the frequency domain in accordance with claims 22 and 23. In further addition, Applicants respectfully submit that neither Grimbergen nor any other cited reference teaches, hints or suggests to determine an etch rate as a function of a change in the frequency of the peak in the frequency domain in accordance with claim 23. As such Applicants respectfully submit that claims 21-23 are patentable over Grimbergen.

Regarding claim 29-31: Applicants respectfully submit that claims 29-31 are patentable over Grimbergen for the same reasons set forth above with respect to claims 21-23.

In light of the above, Applicants respectfully request that the Examiner withdraw this rejection.

Applicants have added new claims 32-35. Applicants respectfully submit that new claims 32-35 are patenable over the references for the reasons set forth above.

In light of the above, Applicants respectfully submit that all the remaining claims are allowable, and Applicants respectfully request that the Examiner reconsider the case and pass the case to issue. Should the Examiner have any questions or wish to discuss any aspect of the application, a telephone call to the undersigned would be welcome.

Respectfully submitted,

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